

PYCNOGONUM (PYCNOGONIDA: PYCNOGONIDAE) FROM AUSTRALIA WITH  
DESCRIPTIONS OF TWO NEW SPECIES

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Abstract

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Australian representatives of the genus *Pycnogonum* Brünnich, 1764 are reviewed. *Pycnogonum carinatum* sp. nov. and *P. clarki* sp. nov. are described and compared with their congeners. *Pycnogonum occa* Loman, 1908 is provisionally recorded from the continental slope of eastern Bass Strait, greatly extending its geographic range from tropical to temperate Australia. The range of *P. moolenbeeki* Stock, 1992 is extended to northern Australia. Type specimens of *P. aurilineatum* Flynn, 1919, *P. torresi* Clark, 1963, *P. tuberculatum* Clark, 1963 and the New Zealand species *P. anovigerum* Clark, 1956 are re-examined. The male of *Pycnogonum aurilineatum* and glands surrounding the mouth of *Pycnogonum* species are described. The arrangement of gonopores in five species is reviewed. Gland-like coxal markings were noted in several species. Abnormal development in two specimens of *P. clarki* sp. nov. is recorded. A key to the seven Australian species is provided.

Introduction

The genus *Pycnogonum* Brünnich, 1764 consists of over sixty species characterized by a robust body, well developed proboscis and complete absence of chelifores and palps. In the absence of ovigers in some species, eggs are cemented directly to the ventral surface of the trunk. *Pycnogonum* are specialized feeders, most often recorded in association with anemones on which they feed. Records are predominantly from shallow waters but are known from depths exceeding 2000 m. This paper reviews the Australian fauna and reports on two additional species new to science. Of the seven species now recorded, five appear to be endemic to the Australian region. The arrangement of gonopores in males and females was examined and pale spots (herein provisionally referred to as coxal glands) on the coxae noted by Bouvier, 1913 and Flynn, 1919 were recorded in several species. Gland-like structures surrounding the mouth were also recorded.

Measurements of the coxae can vary significantly depending upon which surface they are taken. For this reason measurements have been taken on the lateral surface that presents the

greatest length and excludes the articular membrane. Similarly, the proboscis is measured laterally excluding the articular membrane which in some cases exceeds 20% of the proboscis length when extended. Trunk length is measured from anterior margin of cephalothorax to base of abdomen. Type material lodged in Australian institutions was re-examined. New type material has been lodged in Museum Victoria. Abbreviations are: NMV, Museum Victoria, Melbourne; AM, Australian Museum, Sydney; MRG, Marine Research Group of Victoria; TM, Tasmanian Museum, Hobart; NTM, Northern Territory Museum, Darwin. One millimetre scale bars refer to trunk size.

PYCNOGONIDAE Wilson

*Pycnogonum* Brünnich, 1764

*Remarks.* The genus *Pycnogonum* is divided into three subgenera based on the characteristics of the male oviger (Stock, 1968): *Pycnogonum*, oviger 8–9 segmented, terminal claw present; *Retroviger*, oviger 4–7 segmented, with or without terminal claws; and *Nulloviger*, without ovigers. Of the seven Australian species

recorded, three can now be assigned to *Nulloviger* and two to *Retroviger*. These are *P. (Nulloviger) carinatum* sp. nov., *P. (Nulloviger) tuberculatum*, *P. (Nulloviger) moolenbeeki*, *P. (Retroviger) clarki* sp. nov. and *P. (Retroviger) aurilineatum*. Males of *P. occa* Loman, 1908 and *P. torresi* have not been found and cannot be assigned to a subgenus. Hooper (1980) recorded

*P. rickettsi* Schmidt, 1934 from Arrawarra Headland, northern New South Wales but re-examination of his collection found that species not to be present. The type locality for *P. rickettsi* is Monterey Bay, California. Until further material comes to hand, this species is not included as an Australian record.

#### Key to Australian species of *Pycnogonum*

1. Dorsomedian processes on trunk segments 1-3 pointed, height about 3 times basal diameter.....*P. occa* Loman, 1908
- Dorsomedian processes on trunk segments 1-3 blunt or rounded, height about equal to, or less than basal diameter.....2
2. Proboscis with dorsomedian tubercle ..... 3
- Proboscis without dorsomedian tubercle..... 4
3. Proboscis greater than 40% length of trunk. Tibia 1 greater than 60% length of femur. Propodus 3 times as long as wide.....*P. tuberculatum* Clark, 1963
- Proboscis less than 40% length of trunk. Tibia 1 less than 60% length of femur. Propodus about 2.5 times as long as wide.....*P. moolenbeeki* Stock, 1992
4. Post-ocular tubercle present .....*P. carinatum* sp. nov.
- Post-ocular tubercle absent .....5
5. Tibia 2 greater than 50% of tibia 1. Abdomen rounded.....*P. torresi* Clark, 1963
- Tibia 2 very short, less than 20% of tibia 1. Abdomen truncate..... 6
6. Trunk conspicuously reticulate, unpigmented. Femur and propodus of about equal length, propodal and tarsal spines loosely arranged in median row.....*P. clarki* sp. nov.
- Trunk shagreened, typically dark with pale dorsomedian stripe. Femur longer than propodus, tarsal and propodal spines arranged into dense clusters..... *P. aurilineatum* Flynn, 1919

#### *Pycnogonum (Nulloviger) carinatum* sp. nov.

##### Figure 1A-G

**Material examined.** Holotype. Vic. Beware Reef, near Cape Conran (37°49.35'S, 147°47.39'E), 5-6 m, SCUBA, T. O'Hara and A. Plummer, 15 Apr 1998, (stn WV 11), NMV J48800 (male, ovigerous).

Other material. Vic. Southern Port Phillip Bay (38° 17.30'S, 144° 41.40'E), 7 m, dredge, MRG, 25 Jul 1987 (stn SPPS 5), NMV J48801 (1 female, gravid). Victory Shoal, southern Port Phillip Bay (38°17.00'S to 38° 16.80'S, 144° 37.70' to 144° 38.30'E), 3-6 m, SCUBA/dredge, MRG, 30 Mar 1986, (stn SPPS 3), NMV J48802 (1 male, ovigerous. Trunk of specimen lost). 'The Wall', Port Phillip Heads, in red algae collection, 15 m, SCUBA, J.E. Watson, 9 Jun 1984, NMV J48803 (1 female, gravid). Victory Shoal, Port Phillip Bay, 6 m, dredge, MRG, 30 Mar 1986, (stn SPPS 3), NMV J48804 (protonymphon, 3 pair of legs developed). Off Shortland's Bluff, Port Phillip Bay (38° 17.20'S to 38° 16.90'S to 144° 38.80'E to 144° 40.30'E), 5-15 m, dredge, MRG, 02 Nov 1986, (stn SPPS 4), NMV J48805 (protonymphon, 3 pair of legs developed). Cheviot Beach, Point Nepean (38° 18'S,

144° 40'E), *Phyllospora/Ecklonia* habitat, 3-3.5 m, SCUBA, T. O'Hara and A. Plummer, 31 Mar 1998, (Stn WV5), NMV J48806 (2 females). Queenscliff, Port Phillip Bay, 7 m, SCUBA, D. Staples, 20 Mar 1992, NMV J48807 (1 male?). Cape Paterson, Twin Reefs (38° 40'S, 145° 39'E), intertidal, G.C.B. Poore and R.S. Wilsnn, 5 Mar 1982, (stn CPA 20), NMV J48808 (1 specimen, sex indeterminate). Port Phillip Bay (38° 17.00'S to 38° 16.80'S, 144° 37.70'E to 144° 38°30'E), 3-6 m, SCUBA, MRG, 21 Jan 1989, (stn SPPS 3), NMV J48809 (1 juv). Cape Paterson, 1 km E of Harmers Haven (38° 34'S, 145° 40'), approx. 300 m offshore, algal turf, 5-6 m, SCUBA, R.S. Wilson and C. Larson, 6 Mar 1982, (stn CPA 15), NMV J48810 (1 female). Tas. Arched l., (43°26.32' S 147°20.19'E), 6 m, J. Walls, (undated), NMV J48811 (1 specimen, sex indeterminate). WA, Breaksea l., SW corner, (35° 3.90'S 118° 2.50'E), red algae between *Ecklonia*, 15 m, SCUBA, G.C.B. Poore and H.M. Lew Ton, 7 Apr 1984, (Stn SWA14), NMV J48815 (1 male?).

**Diagnosis.** Trunk with post-ocular tubercle, segments 1-3 with raised transverse ridges each with blunt dorsomedian tubercle. Ovigers absent,

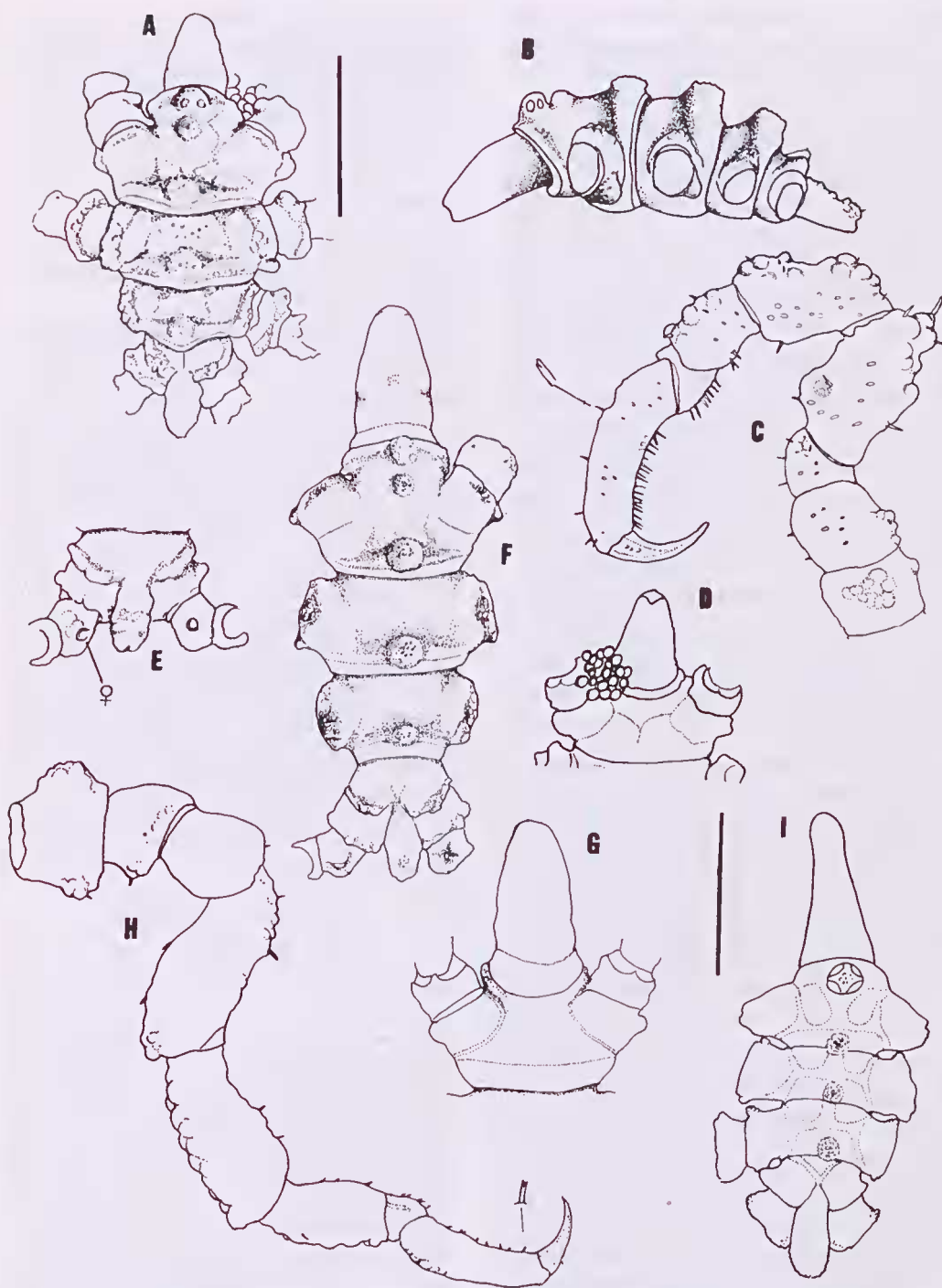


Figure 1. *Pycnogonum carinatum* sp nov. NMV J48800 (figures A-D holotype, male). A, trunk dorsal view. B, lateral view. C, third leg. D, ventral view proboscis and segment 1. NMV J48801 (figures E-G female) E, dorsal view segment 4, coxae 1 and 2. F, trunk dorsal view. G, anterior ventral showing extended articular membrane. *Pycnogonum torresi* AM P13689 (holotype, female) H, third leg. I, trunk dorsal view.



both sexes. Dorsal reticulations obscure or absent. All leg segments tuberculate dorsally, propodus longest segment, sole spines distally cleft, auxiliary claws absent.

**Description.** Integument finely granular, reticulations clearly evident ventrally, obscure, or not visible in dorsal view, single post-ocular tubercle slightly lower than ocular tubercle followed by three raised transverse ridges on trunk segments 1–3, each with blunt dorsomedian tubercle, more prominent in some specimens than others. Lateral processes diverging, distally separated by about own diameter, each with raised dorsodistal nodulous ridge most prominent middorsally and posteriorly-directed ventrodistal process, most pronounced on segments 1–2. Ocular tubercle near anterior margin of cephalothorax, height less than diameter, 4 eyes lightly pigmented. Proboscis robust, slight constriction at about one-third length, tapering distally, without dorsal tubercles. Oral glands present. Articular membrane between trunk segments and at base of proboscis wide, capable of considerable extension and retraction, membrane at base of proboscis folded or collar-like when contracted. Abdomen not quite reaching distal margin of coxa 2 of fourth pair of legs, directed horizontally or slightly ventrad, distally rounded in dorsal view, bearing nodulous dorsodistal elevation, anus terminal. Ovipositors absent in both sexes.

**Legs:** Coxa 1 of all legs with pronounced anterodistal process, dorsodistal margin developed into rugose collar, more pronounced in some specimens but usually absent on the first pair of legs. Coxa 2 with distal rugose collar. Coxae 1 and 2 of about equal length, longer than coxa 3, femur longer than tibia, tibia 1 longer than tibia 2; propodus longest segment. Main claw about 60% of propodal length. Femur with prominent ventroproximal swelling and 2 nodulous dorsodistal lobes, prominent spine between lobes, few smaller spines, some cleft, scattered on all segments. All segments tuberculate dorsally, tubercles themselves minutely granular. Tarsal and propodal sole spines cleft at apex, number widely variable between legs of same specimen and between individuals, consistently less abundant on fourth pair of legs. Sole spines range from 10–30, about 6 spines grouped at base of main claw; tarsal spines 7–30. Auxiliary claws absent. Male gonopores tiny, on ventral surface coxa 2 of fourth pair of legs. Female gonopores well defined, on dorsodistal surface of coxa 2 of fourth pair of legs. Variably defined coxal glands are present on all legs of both sexes.

**Measurements (mm).** Holotype. Trunk length, 1.75; trunk width (across second lateral processes), 1.03; proboscis length, 0.65; abdomen, 0.04; third leg, coxa 1, 0.21; coxa 2, 0.20; coxa 3, 0.16; femur, 0.42; tibia 1, 0.35; tibia 2, 0.25; tarsus (ventral), 0.17; propodus, 0.50; claw; 0.28.

**Distribution.** Central Victorian coast, SE Tasmania and SW Western Australia; 3–15 m depth.

**Etymology.** The specific name alludes to the raised transverse ridges found on the dorsal surface of the trunk segments.

**Remarks.** The integument has the appearance of being embedded with what look like air bubbles or translucent beads which appear not to communicate with the surface. This condition may be as in *P. crosnieri* Stock, 1991, described as “granulated and pitted”. *Pycnogonum carinatum* belongs to a group of species lacking auxiliary claws and ovipositors in both sexes. It shares the presence of a single postocular tubercle with *P. portus*, Barnard, 1946, *P. microps*, Loman, 1904, *P. angulirostrum*, Stock, 1959, *P. arbustum*, Stock, 1966h, *P. forte*, Flynn, 1928 and *P. tumulosum*, Loman, 1908. The new species is closest to *P. microps* from which it can be distinguished by tuberculate and nodulate leg segments, dorsomedian trunk tubercles and distally rounded abdomen (truncate in *P. microps*). *P. carinatum* is smaller than material of *P. anovigerum* from New Zealand, has more prominent trunk ridges and ocular tubercle, possesses a prominent postocular tubercle, and shorter abdomen with terminal anus. The anus in *P. anovigerum* is on the ventrodistal surface of the abdomen.

### *Pycnogonum torresi* Clark

Figure 1H–I

*Pycnogonum torresi* Clark, 1963: 76–77, figs 37 A–D.

**Material examined.** Holotype, Queensland, Murray Island, Torres Strait, 10–15 m, C. Hedley and A.R. McCulloch, 1907, AM P13689 (1 female).

**Remarks.** The body is straw-coloured in preserved material, without markings. Propodal sole spines are blunt, split distally; the proboscis slightly bulbous distally; and oral glands small and inconspicuous. Reticulation of the trunk is more evident than illustrated by Clark. This specimen appears to have dried out at some stage and is in a fragile condition with some damage. Circular markings on the dorsal surface of coxa 2 of all legs appear to support Clark's observation that the specimen is a female, however small

perforations in the position normally occupied by the male gonopores on the damaged last pair of legs may indicate the specimen is male. Additional material is required to clarify the arrangement of gonopores in this species.

*Distribution.* Known only from type locality.

*Pycnogonum (Retroviger) clarki* sp. nov.

Figure 2A–G

*Pycnogonum* species.—Hooper, 1980: 475

*Material examined.* Holotype. New South Wales, Arrawarra Headland (30°17'S, 153°15'E), 0–2.5 m, J.N.A. Hooper 1976, NMV J48812 (male, with slide). Paratypes. Collected with holotype, NMV J48817 (1 female, 1 juvenile male).

*Diagnosis.* Integument strongly reticulate, trunk segments 1–3 with well-defined, rounded processes. Oviger male only, 7-segmented. Propodus approximately equal to length of femur. Tibia 2 shorter than wide. Propodal sole spines cleft at apex, loosely arranged in narrow field along length of propodal sole. Auxiliary claws absent.

*Description.* Entire integument (except for propodus and ovigers) strongly reticulate, straw-coloured in preserved state, without markings. Trunk fully segmented, first 3 trunk segments armed dorsodistally with well defined, rounded process each about equal in height to the ocular tubercle. Lateral processes narrowly separated at base, short, wider than long, segment 4 with low, granular dorsodistal boss. Ocular tubercle low, height less than basal diameter, 4 large eyes lightly pigmented. Proboscis robust, slightly tapered and down-curved, slight constriction at about half length, articular membrane at base of proboscis wide when extended. Oral glands present. Abdomen wedge-shaped, reaching to distal margin of coxa 1 on fourth pair of legs, swollen in mid region, truncate with low dorsodistal tubercle, anus terminal. Oviger of male 7-segmented with strong terminal claw; last segment with 2 small ventral spines and 1 dorsal spine, remaining segments devoid of spines, obscure suture lines separate segments 1–3. Lengths (mm) of male oviger joints are: seg. 1, 0.03; seg. 2, 0.05; seg. 3, 0.14; seg. 4, 0.15; seg. 5, 0.08; seg. 6, 0.10; seg. 7, 0.12; claw, 0.09. Oviger absent in female.

Legs: Femur and tibia 1 subequal. Coxae 1–3 of about equal length, each with distal coarse granular collar, slightly raised on coxae 1–2, articular membrane between segments wide. Tibia 2 as in *P. aurilineatum*, shorter than wide and separated from tarsus by a suture line.

Propodal sole armed with 30–40 spines each with a cleft apex, loosely arranged in a narrow field along length of propodus. Ventrally, coxa 3, femur, tibiae 1 and 2 and tarsus support groups of similar spines in lesser numbers. Main claw about 60% of propodus. Auxiliaries absent. Female gonopores large, well defined, situated on dorso-posterior surface of coxae 2 of fourth pair of legs. Male gonopores tiny, ventral, on coxa 2 of last pair of legs. Obscure middorsal coxal glands present on coxa 2 of all legs in both sexes. These spots are free of reticulations found in the surrounding integument.

*Measurements (mm).* Holotype: trunk length, 1.70; trunk width (across second lateral processes), 1.4; proboscis length, 1.0; abdomen 0.40; third leg, coxa 1, 0.30; coxa 2, 0.35; coxa 3, 0.30; femur, 0.50; tibia 1, 0.52; tibia 2, 0.17; tarsus, 0.10; propodus, 0.53; claw 0.31.

*Distribution.* Known only from type locality.

*Etymology.* This species is named for Prof. W.C. Clark in recognition of having first examined these specimens and for his significant contribution to our knowledge of Australian representatives of this family.

*Remarks.* This species is close to *P. aurilineatum* but is significantly smaller in overall dimensions and bulk. Total length is less than one-third that of (a typical) *P. aurilineatum*. The conspicuous reticulations, absence of pigmentation and body markings and relative length of the propodus (approximately equal length to the femur, about 70 %, in *P. aurilineatum*) further serve as distinguishing characters. The number and arrangement of propodal and tarsal spines, the number of oviger spines, and the less prominent dorsal swelling of the femur are differences that could be age-dependent, but when considered in combination may serve as additional points of difference. Both the female and juvenile are abnormal specimens. The juvenile has four legs on the left side but only three legs on the right. The dorsal surface of trunk segment 4 of the female is incompletely developed and the mid-dorsal tubercle is atrophied and offset. The dorsal tubercle on segment 3 is low, flat and wart-like, possibly also an abnormality. On the ventral surface, trunk segmentation is complete. Such morphological abnormalities are not unique but nevertheless rarely recorded. In both instances there is no evidence of trauma. *Pycnogonum gnyanae* Stock, 1975 also resembles this species but can be distinguished by the longer tibiae 2 and placement of the female gonopores on legs 3 and 4.

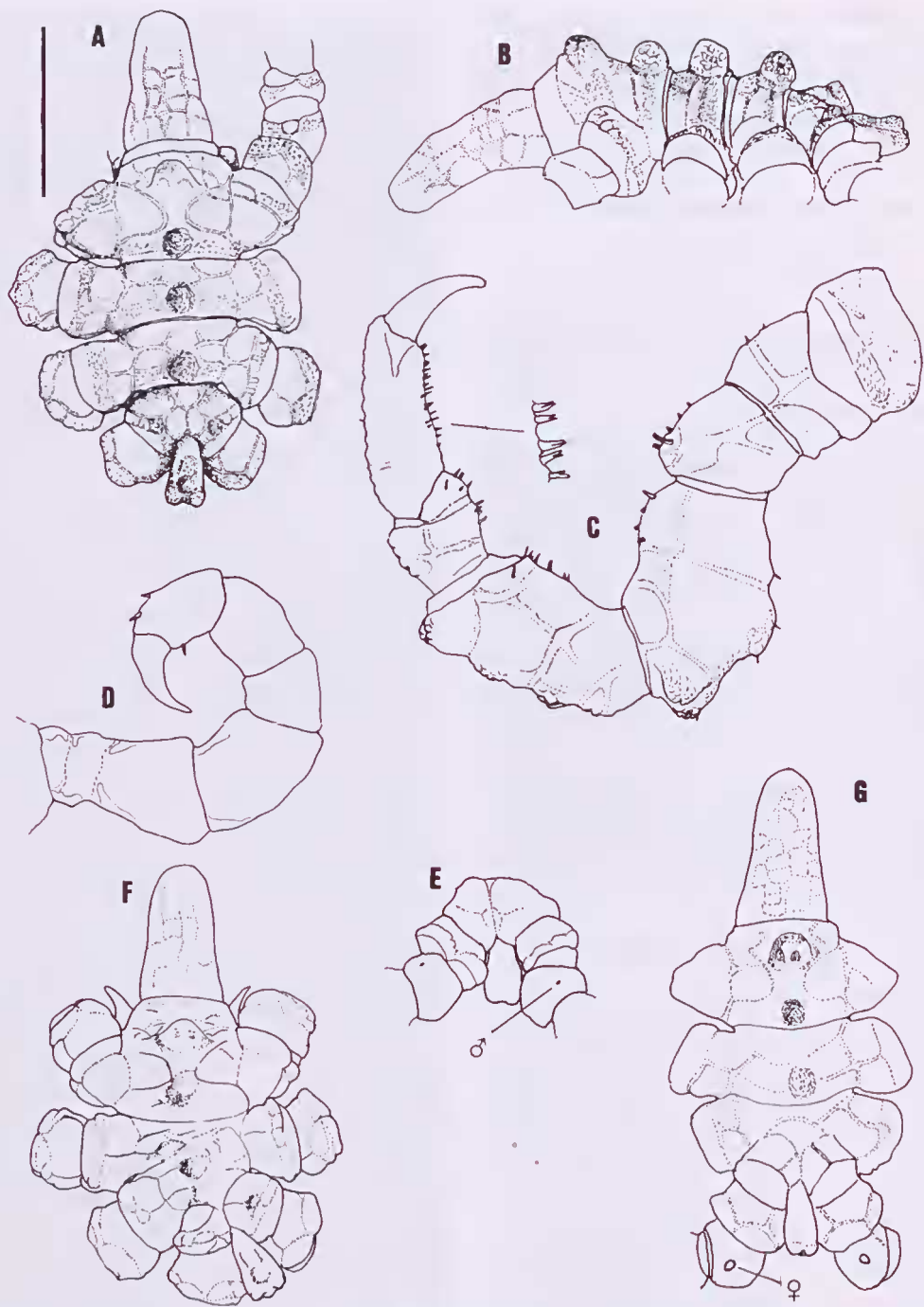


Figure. 2. *Pycnogonum clarki* sp. nov. NMV J48812 (all figures except E, F, of male holotype). A, trunk, dorsal view. B, trunk lateral view. C, third leg. D, oviger. E, ventral view segment 4. NMV J48817 F, juvenile male trunk, dorsal view. G, female trunk, dorsal view.



*Pycnogonum occa* Loman

## Figure 3A–D

*Pycnogonum occa* Loman, 1908: 35–36, pl. 12 figs 171–174.—Bouvier, 1922:116.—Stock, 1966a: 401 (in key).—Stock, 1968: 61–62, fig 22c–e.—Child, 1988: 27.—Stock, 1997: 389–409.

**Material examined.** Victoria, S of Point Hicks eastern Bass Strait (38°19.6'S to 38°19.00'S, 149°24.3'E to 149°27.3'E), 930–951 m, WHOI epibenthic sled, rock/rubble/clay/sand and biogenic sediments, M. Gomon et al. on ORV Franklin, 23 Jul 1986 (stn SLOPE 33), NMV J48813 (1 juvenile).

**Remarks.** All previous records are from tropical waters. Type material was collected from the Ceram Sea, Indonesia, at depths of 567 and 835 m (Loman, 1908). Subsequent records are from the Kermadec Trench at 2470 m (Stock, 1968), east of Luzon Island the Philippines (*Albatross* Station 5447) at 567 m (Child, 1988) and New Caledonia at 502–570 m (Stock, 1997). Slight morphological variations have resulted in the cautious assignment of all records to this species and prompted Stock (1997: 407) to comment that this species is “apparently of variable morphology.” This uncertainty has not been assisted by records of juvenile specimens and the apparent absence of males. Loman (1908) did not mention gonopores and his identification of his ten specimens as female was probably based solely on the absence of ovigers. Should ovigers be absent in both sexes he probably would not have recognised any males had they been present. Stock’s (1968) Kermadec Trench specimens differ from other material, notably in the presence of humps on the anterior margin of the cephalothorax, the presence of prominent laterodistal tubercles on the first coxae, in the larger size, in the shape of the abdomen and possession of a heavily sclerotized integument. These specimens were also collected from much deeper water. I agree with Child (1988: 27) that the assignment of the Kermadec specimens to *P. occa* is questionable. The Bass Strait specimen is distinguished by its small size (3.18 mm total length) and the absence of a middorsal tubercle on the fourth trunk segment, a character described by Loman (1908) as a knot-like process and used by Stock (1966a) in his key to separate this species from its congeners. It agrees most closely with the specimens collected east of Luzon I. (Child, 1988:27) with which it shares the more slender proboscis and “slight incipient reticulations” in the integument. As Child made no mention of the absence of a dorsal tubercle on the fourth trunk segment in the Luzon I. specimen, it is presumed to be present. He noted however that the trunk

tubercles were more blunt and broad compared to other material and attributed those differences to the immaturity of his specimen. Stock (1997) did not comment on the morphology of the New Caledonian record and no comparison with that specimen can be made. Gonopores and coxal glands not evident, either undeveloped or obscured by the fine reticulations. Glands not evident on the small oral surface. Ovigers are absent. This is yet another specimen provisionally assigned to *P. occa*. Figures are provided to enable future comparison with this specimen.

**Distribution.** This record extends the distribution from the tropical waters of the Ceram Sea, Indonesia; east of Luzon I. the Philippines and New Caledonia to the temperate waters of southern Australia; 502–2470 m depth.

*Pycnogonum (Nulloviger) tuberculatum* Clark

## Figure 3E–G

*Pycnogonum tuberculatum* Clark, 1963: 77–79, figs 38 A–D.—Stock, 1994: 68.

**Material examined.** Vic. WSW of Gabo I., 130 m, trawled, K. Moller on FV *Durraween*, Dec 1929, AM P13690, AM P13691 (female holotype, 2 female paratypes). NSW. 14 mi. off Batemans Bay, 140 m, trawled, K. Moller on FV *Durraween*, no date, AM P13693 (1 female). Tas. 1.2 km E of Cape Boulander, (42°34'S 148°6'E), fine bryozoan/shell, 50 m, WHOI epibenthic sled, R. Wilson on RV *Challenger*, 23 Apr 1985 (stn TAS 29), NMV J48814 (1 male).

**Remarks.** The Tasmanian specimen is in general agreement with Clark’s (1963) description and falls within the recorded depth range. Ovigers are absent, placing this species in the subgenus *Nulloviger*. The most significant omission from Clark’s description is the presence of two heavy dorsodistal lobes and two dorsolateral digitiform processes on the femora. Clark’s fig. 38B also incorrectly shows the presence of a segmentation line between trunk segments 3 and 4. Spines on the tarsus and ventrodistal surface of tibia 2 are considerably more dense and abundant than illustrated by Clark. The prominent dorsal tubercle on the femur is flanked by two low dorsolateral bosses. Coxae 1 and 2 with low distal dorsolateral bosses. Tiny male gonopores are present on the ventral surface of coxa 2 of the fourth pair of legs in all the material examined. Well defined, coxal glands are present on the dorsodistal surface of the second coxae of all legs. Most glands accompanied by a small spine on the proximal margin. A few spinules are scattered around the tip of the proboscis. Oral glands are not evident. *Pycnogonum tuberculatum*, *P. nodulosum* Dohrn, 1881

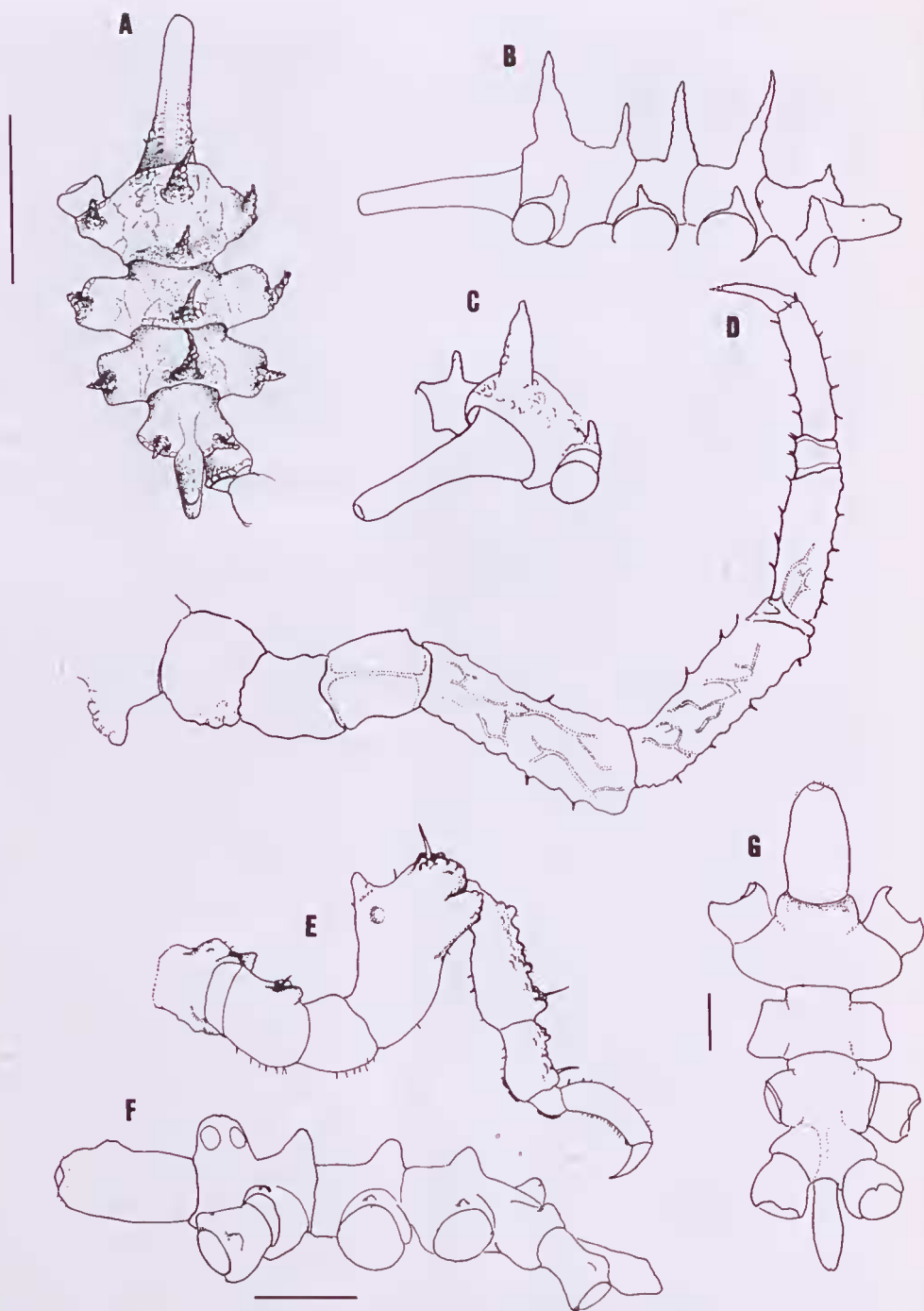


Figure 3. *Pycnogonum occa* Loman, 1908, NMV J48813 (juvenile). A, trunk, dorsal view. B, trunk, lateral view. C, proboscis and trunk anterior. D, second leg. *Pycnogonum tuberculatum* Clark, 1963, NMV J48814 (all figures of male). E, third leg; F, trunk, lateral view. G, trunk, ventral view.



and *P. moolenbeeki* can be distinguished from their congeners by the basal articulation of the abdomen, possession of a single median tubercle on the proboscis and in the general shape of the femur. *P. nodulosum* differs most significantly in the distinct segmentation of trunk segments 3 and 4. *Pycnogonum tuberculatum* is in close agreement with Stock's description of *P. moolenbeeki* with which it shares possession of blunt propodal spines without evidence of bifurcation, the similar distribution of leg spines and the fusion (or partial fusion) of trunk segments 3 and 4. *Pycnogonum tuberculatum* can be distinguished from *P. moolenbeeki* by its larger overall size, shorter proboscis relative to trunk length, longer tibia 2 and more slender propodus. Dorsomedian trunk tubercles appear to be more prominent in *P. tuberculatum* though this may be variable. In the general shape of the femur, *P. lobipes* Stock, 1991 also agrees with these species but otherwise differs in several respects, notably the absence of a median process on the proboscis, the distinct segmentation of trunk segments 3 and 4 and the non-articulated abdomen.

**Distribution.** Tasmania, Bass Strait, southern New South Wales and north of Papua New Guinea; 1–148 m depth.

***Pycnogonum (Nulloviger) moolenbeeki* Stock**

*P. moolenbeeki* Stock, 1992: 95–97, fig. 11.

**Material examined.** Timor Sea, Ashmore Reef, Lagoon Patch Reef, near NW entrance, coralline algae and dead coral rubble, 5 m, B.C. Russell, 23 Feb 1981, NTM N9 (1 male).

**Remarks.** This specimen possesses a number of characters intermediate between *P. tuberculatum* and Stock's description of *P. moolenbeeki*. It agrees with *P. tuberculatum* in possession of prominent dorsomedian tubercles on trunk segments 1–3, complete fusion of trunk segments 3 and 4 and, although the dorsal tubercle in *P. moolenbeeki* appears to be generally less acute, in the shape of the femur. However the smaller overall size (trunk length 1.70 mm, measured from anterior margin of cephalothorax to base of abdomen), the proportionally longer proboscis (42% of trunk), the shorter tibia 1 (53% length of femur) and the more robust propodus align this specimen more closely with *P. moolenbeeki*. The tropical water habitat and depth range 0–5 m are also in keeping with the type locality of *P. moolenbeeki*. Tiny male gonopores pores are present on the ventral surface of coxa 2 of the fourth pair of legs. Oral glands are present. Coxal

glands are present on all legs. This record represents a significant extension of range from the Gulf of Oman. The status of this material should be confirmed by re-examination of the type material and comparison with female specimens from the Australian region.

***Pycnogonum (Retroviger) aurilineatum* Flynn**

Figure 4A–H

*Pycnogonum aurilineatum* Flynn, 1919b: 92–95, plate X111, figs. 1–2; plate XIV, fig. 3.—Stock, 1973: 125.

**Material examined.** Holotype. Tas. Port Arthur, Mr E. Mawle? 1918?, TM J7/13083 (1 female).

Other material. Vic. Harpers Haven, intertidal, MRG, 18 May 1983, NMV J12936 (1 male, ovigerous.). Shoreham, rocky shallows, M. O'Loughlin, 13 Jan 1981, NMV J12937 (1 female). Flinders, ocean reef, M.P. Marrow, 29 May 1979, NMV J12939 (1 female). Peterborough, intertidal, C. Handreck, 22 Feb. 1984, NMV J12941 (1 female). Cat Bay, Phillip I., G.C.B. Poore (no date), NMV J12938 (1 female). Torquay, Point Danger, R. Burn, (no date), NMV J12940 (1 female). Lake Tyers, Red Bluff, intertidal, C. Handreck, 12 April 1984, NMV J48816 (1 male).

**Distribution.** Investigator Group, Great Australian Bight, South Australia; SE Tasmania to Coffs Harbour, New South Wales; intertidal to 23 m depth.

**Remarks.** This species was described from two female specimens. Additional material expands our knowledge of female morphology and enables observations of male characteristics. Flynn accurately described the appearance of the integument as shagreened (as in rough untanned leather) and is comparable to the illustration of *P. elephas* (Stock, 1966a: figs 4a, e). The integument is generally dark brown-black with a characteristic pale middorsal band which runs the length of the first three trunk segments and partially on to segment 4. This character is shared with *P. calcinatum* Bamber, 1995 and persists in preserved material. Characters that otherwise distinguish these two species are well documented (Bamber, 1995). Distal to an annular constriction around the propodus, the integument is pale. Raised areas with coarse granulation's often have a 'burnished' appearance, being paler in comparison to the surrounding integument. In some (recently moulted) specimens the colour of the integument is lighter or pale pink (Staples, 1999). The pale dorsomedian band usually persists at all stages. The articular membrane at the base of proboscis is wide, when extended it exceeds 25% of the total

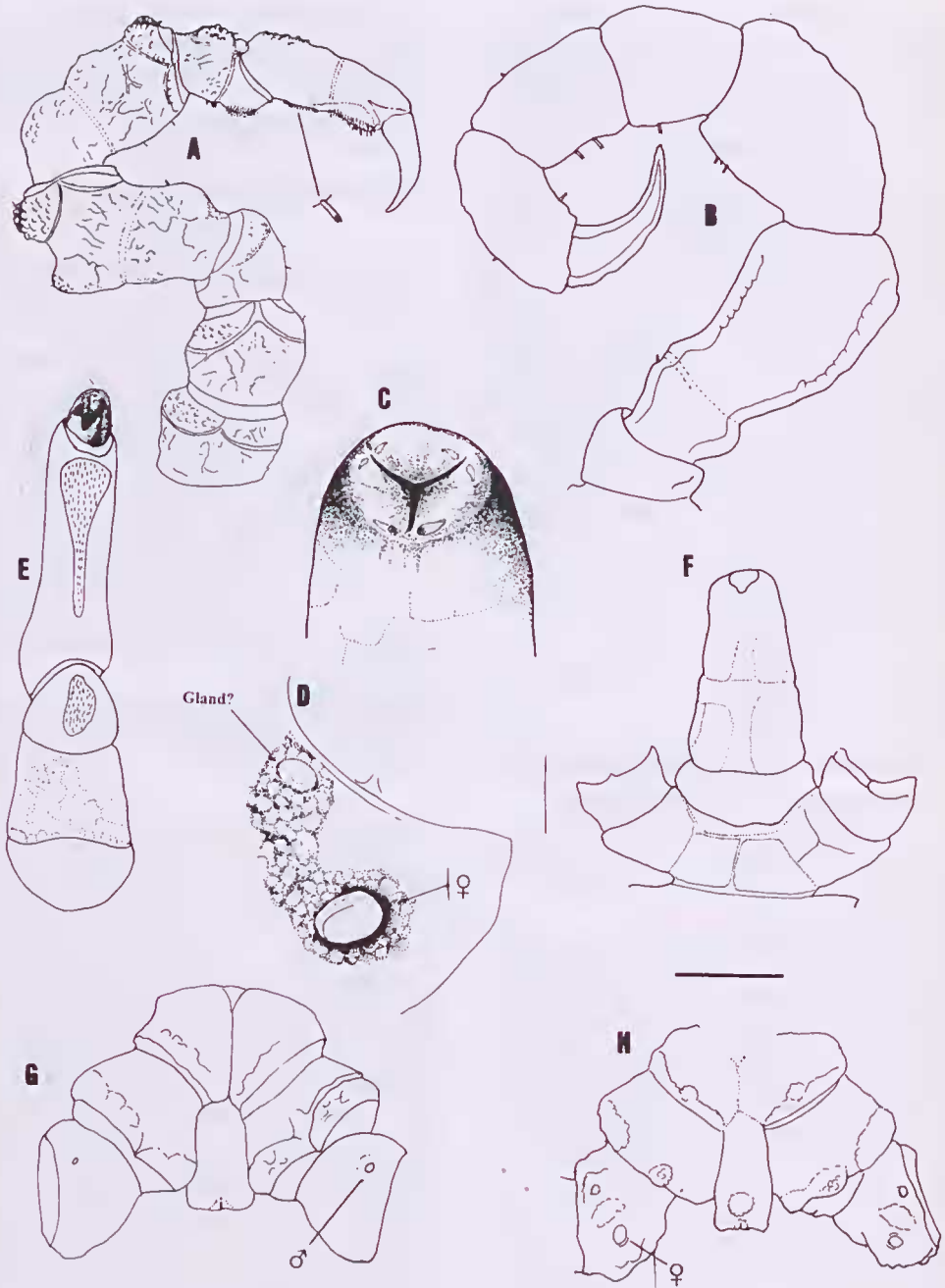


Figure 4. *Pynogonum aurilineatum* Flynn, 1919. NMV J12936 A, male third leg. B, male oviger. NMV J12940 C, female mouth showing position of oral glands. D, female, coxa 2 dorsal, detail of coxal gland in relation to gonopore. TM J7/13083 E, female (holotype), distal segments leg 3. NMV J12937 F, female, ventral surface of proboscis and cephalothorax showing articular membrane. NMV J48816 G, male ventral, trunk segment. NMV J12938 H, female dorsal, trunk segment 4.

proboscis length measured ventrally. Oral glands are well defined. Swellings on the legs are variable even within the same specimen, being more acute on some legs than others. The dorsal surface of all leg segments is finely tuberculate with raised areas of the trunk and legs more coarsely granular than the remaining integument. Tiny robust spines are scattered over the trunk and legs. Coxa 1 of all legs has a distal raised shoulder divided middorsally. The femur, tibia 1 and propodus are slightly constricted at one-third to half their length and encircled by what appears to be a broad reticulation line. Dorsodistally the femur and tibiae terminate in a bilobed process with one or two small spines originating between the processes; bilobed processes on tibiae 2 are less pronounced. Ventrodistally, tibia 2 supports a group of about six spines. Small, cleft tarsal spines are numerous, arranged in an irregular oval pattern on an area of light-coloured cuticle. This gives the appearance of the spines being placed on a 'pad' which may be analogous to the "shining patch" recorded in *P. angulirostrum* Stoeck, 1959. Stoeck also compared that species to *P. aurilineatum* and illustrated (fig. 9d) what appears to be a similar arrangement of spines. The propodal sole is lined with a dense field of tiny spines arranged in a group which is broad distally, gradually tapering anteriorly towards the tarsus. Female gonopores are conspicuous, placed on the dorsodistal surface of second coxa of the fourth pair of legs and surrounded by raised integument. Coxal glands are present all legs. The surface of the gland is smooth, generally shiny and in some instances transparent.

The smaller male is in close agreement with female holotype. Gonopores are small and inconspicuous, placed on the ventral surface of coxa 2 of the fourth pair of legs. The oviger is 7-segmented, terminating in strong, curved claw. The segmentation line between oviger segments 2 and 3 is not well defined. In the specimens examined, spines on the distal four oviger segments vary in number, those on segment seven, 1 or 3; segment six, 1 or 2; segment five, 1 and segment four, 1, 2 or 3. Most spines have a cleft tip.

Lengths (mm) of male oviger joints are: seg. 1, 0.13; seg. 2, 0.13; seg. 3, 0.37; seg. 4, 0.36; seg. 5, 0.20; seg. 6, 0.26; seg. 7, 0.26; claw 0.27.

Specimens have been recorded in association with solitary corals, corallimorpharians and anemones (Staples, 1997). This species is in close agreement with *Pycnogonum madagascariensis* Bouvier, 1911, redescribed by Arnaud (1971). Arnaud neither illustrated nor discussed the

arrangement of the propodal and tarsal spines in detail, however her illustration of the tarsus and propodus in lateral view appear to agree with *P. aurilineatum*. The most notable distinguishing feature appears to be the strongly reticulate integument of *P. madagascariensis* and the absence of a dorsal process on the femur which is present but variably developed in *P. aurilineatum*. In the absence of a record of a male *P. madagascariensis* no further comparison can be made. *Pycnogonum aurilineatum* is the most frequently recorded representative of the genus along the southern Australian coastline.

### Remarks

Structures on the oral surface and coxae 2 have are tentatively recognized as glands however histological examination is required to positively establish their function.

*Oral glands.* Six tear drop-shaped oral glands are recorded in Australian species of *Pycnogonum*. These unpigmented glands are placed around the outer margin of the mouth, one pair at the base of each jaw. These glands may be inconspicuous, particularly in small specimens, and are probably present in all species. The same glands are present but previously not recorded, in the predominantly Northern Hemisphere species *P. littorale* (Ström, 1762), and the Antarctic species *P. gordonae* Pushkin, 1984. Associations between the Pycnogonidae and anemones are well documented, being found inside and outside their host. These glands that may excrete a digestive enzyme breaking down tissue that can be readily sucked into the proboscis.

*Coxal glands.* In his description of *P. aurilineatum*, Flynn (1919: 93) was of the opinion that "yellowish spots" present on the dorsal surface of coxae 2 were referable to the pale markings observed on *Pentapycnon charcoti* Bouvier, 1913, which Bouvier thought to be glands. Type specimens of *P. tuberculatum* and *P. moolenbeeki* have been described as females based on the presence of gonopores on the dorsal surface of coxae 2 of all legs. However, re-examination of type material of *P. tuberculatum* and a specimen of *P. moolenbeeki* from northern Australia, shows that while coxa 2 of all legs does possess a dorsal gonopore-like spot, a male gonopore is also present on the ventral surface of coxa 2 legs 4. Either, these species are hermaphroditic, or, the dorsal spots are as Bouvier and Flynn thought, glands. The spots are smooth and shiny and smaller than the typical female gonopore.



Although in some specimens these spots are more clearly defined, there appears to be no disruption of the integument. For these reasons I believe the spots more likely to be glands than gonopores but whether they are a form of cement gland or serve some other function has not been determined. As with the gonopore, each gland is usually accompanied by a tiny spine on its proximal margin.

**Gonopores.** In the genus *Pycnogonum*, gonopores vary in number and placement. Gonopores have been recorded on the dorsal and ventral surface of coxa 2 of all legs, dorsal and ventral surface of the fourth pair, ventral surface of legs 3 and 4, or the ventral surface of the third pair only. The most common arrangement is for female gonopores to be on the dorsodistal surface of coxa 2 of leg 4 and for the smaller, less conspicuous male gonopores to be located ventrally. These positions are consistent with the observed reproductive strategy of *P. littorale* (King, 1973: 72) and *P. aurilineatum* (Staples, 1999: 317) in which the gonopores of both sexes are opposed during the transfer of eggs. The placement of the male gonopores on the ventral surface of coxa 2 of leg 4 appears to hold true for all Australian species but due to absence of material and possible confusion with coxal glands, the number of female gonopores is uncertain. Gonopores in *P. aurilineatum*, *P. clarki* and *P. carinatum* are confined to legs 4; the male gonopore ventral and female dorsal. The possible presence of gonopores on the ventral surface of the legs 4 in the holotype of *P. torresi* raises the possibility that this specimen also shares these characters.

Should my conclusion be correct, *C. mouilliferum* Stock, 1991 from New Caledonia appears to be the only remaining species described as having female gonopores on the middorsal surface of coxa 2 of all legs. Re-examination of the type material is required to verify the number of gonopores in that species.

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